Appendix E: Innovative Technologies

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Technology	Demonstration	Implementation	Unit Cost
Remediation of Explosives/Organics Contaminated Soils			
Physical Separation	1996	1998	$40-$200/Ton
Composting	1991	1993	$100-$400/Ton
Bio-Slurry	1994	1996	$50-$200/Ton
In Situ Biodegradation	1996	1998	$50-$100/Ton
Chemical Extraction	1996	1999	$50-$200/Ton
Electrokinetics	1997	2000	$30-$75/Ton
Remediation of Explosives/Organics Contaminated Groundwater			
OZONE	1993	1995	$0.5-$10/1000 Gal
Peroxone	1994	1996	$0.10-$2/1000 Gal
Advanced Adsorption	1997	1999	$0.02-$1/1000 Gal
Ex Situ Biotreatment	1997	1999	$0.02-$2/1000 Gal
In Situ Biotreatment	1997	1999	$0.02-$1/1000 Gal
Remediation of Metals Contaminated Soils			
Physical Separation	1995	1998	$30-$200/Ton
Electrokinetics	1997	1999	$20/Ton
Metal Extraction	1995	1996	$40-$125/Ton
Remediation of Metals Contaminated Groundwater			
Ion Exchange	1995	1998	$0.10-$40/1000 Gal
Xanthate Precip.	1996	1998	$0.75-$2/1000 Gal
Site Characterization/Detection of Buried Unexploded Ordnance			
STOLS	1994	1995	$1,600/Acre
RADAR	1994	1995	$1,000/Acre
Multi-Sensor Ground Platform	1996	1997	$600/Acre
Multi-Sensor Airborne Platform	1997	1998	$1,200/Acre

Cleanup Technologies (Continued)

Technology	Demonstration	Implementation	Unit Cost
Remediation of Buried Unexploded Ordnance			
Enhanced UXO Tech.	1995	1996	$50,000/Acre
Remote Detection/Removal	1996	1997	$40,000/Acre
Characterizing Contaminants in Soils and Groundwater			
POL	NOW	1993	$10-$40/FT
Explosives/Energetics	1994	1995	$10-$40/FT
Solvents	1996	1997	$10-$40/FT
Heavy Metals	1996-97	1998	$10-$40/FT
Treatment of Fuels/Solvents in Soils			
Bioventing (Fuels)	1993	1995	$5-$30/Ton
RF Heating/Vapor Extraction	1993	1995	$40-$60/Ton
Steam Injection/Vapor Extraction	1994	1995	$50-$80/Ton
Advanced Biotreatment (Solvents)	1996	1999	$70-$80/Ton
Treatment of Fuels/Solvents in Groundwater			
Crossflow Air Stripping with Catalytic Oxidation	1993	1996	$1.5-$5.5/1000 GAL
Liquid Phase Catox	1995	1997	$3/1000 GAL
In Situ Bioremediation	1996	1997	$1-$6/1000 GAL
Plume Retardation	1999	2000	$1-$2/1000 GAL
DNAPL Remediation	2000+	2000+	$15-$30/1000 GAL

Appendix E-2: Environmental Security Technology Certification Program Projects

In-situ Anaerobic Bioremediation of Fuel Contaminated Groundwater at NWS Seal Beach. This technology is applicable to the remediation of groundwater with fuel hydrocarbons, such as gasoline. The process involves placement of wells at a contaminated site and adding nutrients to enhance anaerobic biodegradation. As the microorganisms did not need oxygen, this process costs to implement than more conventional aerobic systems. For further information, contact NFESC at telephone (805) 982-1616.

Full-Scale Demonstration of Vitrification Technology on Contaminated Soils and Sludges. This technology is applicable to virtually all types of contaminated soils. Recent advances in the technology have reduced the cost of implementing this technology. The demonstration analyzed the cost of a new system and determine its effectiveness in the field. For further information, contact NFESC at telephone (805) 982-1671.

Small Arms Range Remediation. This joint project with the Army and Bureau of Mines demonstrated physical separation and soil washing technologies to remove lead particles from bullet-laden soil found in impact berms at small arms ranges. For further information, contact NFESC at telephone (805) 982-1668.

High Resolution Seismic reflection to Characterize and Plan Remediation at Hazardous Waste Sites. This seismic technology is a non-invasive technique to identify contaminant migration pathways, to determine the subsurface structure and stratigraphy to optimize the placement of remediation systems, and possibly directly detect the presence of DNAPLs. For further information, contact NFESC at telephone (805) 982-4833.

Permeable Reactive Wall Remediation of Chlorinated Hydrocarbons in Groundwater. This in situ permeable reactive wall, composed of fine iron powder, is placed down-gradient of the DNAPL contaminant plume. The DNAPLs react with the iron to form chloride ions, effectively dechlorinating the DNAPLs to harmless products. For further information, contact NFESC at telephone (805) 982-1671.

Appendix E-3: Hydrocarbon National Test Site Projects

BioCell Treatment of Petroleum Contaminated Soils. This small-scale ex-situ technology uses naturally occurring microbes to destroy organic contaminants in soil. For further information, contact U. S. Army Waterways Experiment Station at telephone (601) 634-3815, or NFESC at telephone (805) 982-1636.

Bio Pile Remediation. This ex-situ technology uses naturally occurring microbes to destroy organic contaminants in soil. For further information, contact NFESC at telephone (805) 982-1808 or (805) 982-4853.

Groundwater Circulation Well Environmental Cleanup Systems. This in-situ remediation technology provides a cost-effective method to remediate gasoline and other hydrocarbon contaminated groundwater. For further information, contact the Naval Research Lab at telephone (202) 767-0192 or NFESC at telephone (805) 982-1636.

Hot Air Vapor Extraction for Fuel Hydrocarbon Cleanup. This fast-track ex-situ remediation technology combines thermal, heap pile, and vapor extraction techniques to remove and destroy hydrocarbon contamination in soil For further information, contact NFESC at telephone (805) 982-1263 or (805) 982-1636.

Stable Isotopes of Carbon to Monitor Biodegradation of Pollutant Compounds. This study analyzes the ratio between 12C and 13C to determine bioremediation rates of organic compounds. For further information, contact the Naval Research Lab at telephone (202) 767-0192 or NFESC at telephone (805) 982-1636.

Appendix E-4: Available Innovative Cleanup Technologies

The table below is a list of available innovative cleanup technologies. It was mainly taken from the "Innovative Site Remediation Technology" monograph series prepared under EPA auspices and directly supported by the DON.

TECHNOLOGIES THAT CAN BE CONSIDERED AVAILABLE:

Technology	Typical Use
Thermal desorption	Physical separation of organics in soil by heating as part of a treatment train
Air/sparging	Gaseous well extraction (/trmt) of volatiles in the water table by inducing air
Chemical Treatment (including UV)	Use of process chemistry to oxidize, precipitate, or alter state of any contaminant
Soil washing (ex-situ) Soil flushing (in-situ)	Use of primarily water to clean granular soil by dissolution of contaminant
Chemical Extraction (ex-situ)	Use of solvent/chemicals to separate difficult contaminants from soil/water
Vacuum Extraction	Gaseous well systems for volatile organics in permeable soils w/heat for non-volatile
Ex-situ bioremediation	Augmented HC trmt in rows/piles/compost (soil) and reactors (soil slurry or water)
In-situ bioremediation	Augmented chain HC trmt in place (soil or water) including induced air *bioventing*
Natural attenuation	Oxidation/reduction by indigenous species when longer time can be factored out
Non-clay capping	Evapotranspiration system, drainage control, monitoring only - for landfills
Other[1]	

[1] A technology need not be on this list to be considered innovative, and combinations of technologies are expected to be used.

The Wastech Monograph Series on Innovative Site Remediation Technology includes the following volumes:

- Volume 1 - Bioremediation;
- Volume 2 - Chemical Treatment;
- Volume 3 - Soil Flushing/Soil Washing;
- Volume 4 - Stabilization/Solidification;
- Volume 5 - Solvent/Chemical Extraction;
- Volume 6 - Thermal Desorption;
- Volume 7 - Thermal Destruction; and
- Volume 8 - Vacuum Vapor Extraction.

For information on the Monograph series contact the American Academy of Environmental Engineers by telephone at (410) 266-3311 or by mail at the following address:

American Academy of Environmental Engineers
130 Holiday Court
Suite 100
Annapolis, MD 214021

Appendix E-5: NAVFAC RPM Case Studies

(*Questions/information requested on this form are for guidance only. Please vary the information as you see fit to produce a case study useful to your peers.* ***This form will not exceed 2 pages*****)**

Date prepared

SECTION I: SITE INFORMATION

SITE/LOCATION:	site number and Naval Activity, City, State
DESCRIPTION:	brief explanatory name
CONTACT:	person, EFD/A and phone number
TECHNOLOGY:	brief identification
CONTAMINANTS:	most important pollutants
LEGAL DRIVER:	usually: NPL, CERCLA non-NPL, UST/POL, or RCRA/SWMU

SECTION II: EXPERIENCES ENCOUNTERED (*answer all applicable*)

RI/FS or RFI/CMS: Give brief site description based on initial studies and sampling and the rationale used to select initial remedy. If an innovative investigation technique, such as cone penetrometer, saved money describe it here and in Section III.

IRA OR PILOT REMEDIATION: If an IRA or pilot technology application was used, explain what happened. If other than full and open competition was used, how was action accomplished?

TREATABILITY STUDY: If a treatability study was performed, explain its results especially if it changed initial thinking.

PRESUMPTIVE REMEDY: If used, how was it chosen? (Put explanation of regulatory approval in Section III.)

RD: Describe the technology. How was it chosen? Who did the design: what was the design/construct interface? What kind of contract was used? Any design problems or hard choices? If proprietary technology or other than full and open competition was involved, how was it done? Describe contracts division assistance here and with RA.

RA/IMPLEMENTATION: Did you get the technology you wanted: how or why not? Who did the work: what kind of contract, role of subcontractors? Did they do a good job? Any problems/unusual circumstances: how were they resolved? Were there differences between design and what's there now? Describe final configuration. Is it working? What is the current status?

SECTION III: REGULATORY REQUIREMENTS/COMMUNITY INVOLVEMENT

FEDERAL: Which EPA region, internal department? Were they cooperative, timely? If not how did you get them involved? What cleanup standards/criteria prevailed? Were they strict or flexible? Did other relevant standards (e.g. air) play an important role? Did EPA have to approve of the technology? What did it take to get that approval? How did EPA play in any TRC/RAB meetings? Was there a ROD, interim ROD: if not what authority was used for the go decision?

STATE: Which agency/division: were they the primary regulator? Was a time factor imposed? Was State approval of technology required? Address similar issues in Federal questions above. How did it go with the State regulators: were local regulators involved? How did you make it work?

COMMUNITY: Was there a TRC: who were they, did they help? Was there a RAB or comparable committee: who were they, how were they involved? Was community approval of technology required/obtained? Were there problems: how did you solve them?

SECTION IV: OPTIONS CONSIDERED/COST AVOIDANCE

Dig & Haul to landfill or incineration (on or off-site) are norms of conventional technology. Pump and treat is conventional where treatment is a process such as carbon adsorption or air stripping. Pump and treat can be innovative. Natural attenuation involving monitoring only is the most innovative. A lot falls in between.

The purpose of innovative technology is to save money. If the technology didn't save, it is a lesson we need to learn. If only one option was considered, could a comparison be made with a conventional technology to arrive at a cost avoidance. If several options were considered, explain how final decision was made. Was there an overriding timing, health, or risk issue that drove the decision regardless of cost.

What thinking related to cost went into the technology decision? Give a **numerical** cost avoidance and explain how it was estimated or explain us if a less costly technology could have been used if overriding factors had not precluded such a decision.

SECTION V: WHAT WORKED WELL

What are you proud of? What did you do right? What gems of wisdom did you apply purposefully or stumble across that you can share with the rest of us. *(think of 'you' as a plural word).*

SECTION VI: IF WE HAD IT TO DO OVER AGAIN

What didn't work *(technical or administrative)*; how would you correct it? What would you have done differently that would have made it easier? Give it your best 20-20 hindsight.

NAVFAC RPM CASE STUDY No. 1

SECTION I: SITE INFORMATION

SITE/LOCATION: Site 21 MCB Camp Lejeune, Jacksonville, NC

DESCRIPTION: Transformer Storage Lot

CONTACT: Katherine Landman, LANTDIV, (804) 322-4818 DSN 262

TECHNOLOGY: Excavation & Off-Site Disposal

CONTAMINANTS: PCBs and Pesticides

CONCENTRATIONS: Pesticides: max detected 34,000 ppb (incl. 4, 4'-DDD, 4, 4'-DDE, 4,4'-DDT, Chlordane). PCBs: max detected 4600 ppb (Aroclor-1260).

ACTION LEVELS: ROD identified remediation goals based on risk as follows: total PCBs 0.37 ppm, 4, 4'DDD 12 ppm, 4, 4'-DDT 8.4 ppm, total Chlordane 2.2 ppm.

LEGAL DRIVER: NPL, FFA

DECISION DOCUMENT: ROD, Explanation of Significant Differences (ESD)

SECTION II: EXPERIENCES ENCOUNTERED

Site 21 has a history of pesticide usage and reported transformer oil disposal. The site was used as a transformer storage lot. Oil was drained from transformers into an on-site pit. Another portion of the site was used for pesticide mixing and for cleaning of pesticide application equipment. Indiscriminate disposal of excess pesticides is also believed to have occurred here.

An RI/FS was initiated in 1993 for Site 21 as part of Operable Unit No. 1 (including Sites 21, 24, and 78). The RI identified three areas of concern (AOCs) of surface soil contamination at Site 21. AOC 1 was located in the northern portion of the site in the vicinity of the transformer oil disposal pit. AOC 1 exhibited elevated levels of PCBs in surface soils. AOCs 2 and 3 were adjacent to one another in the southern portion of the site in the vicinity of the pesticide mixing area. AOC 2 also exhibited elevated levels of PCBs in surface soils. AOC 3 exhibited elevated levels of pesticides in surface soils.

Remediation goals were developed during the FS based on the site risk assessment and regulatory standards and applicable references. Significant potential ecological risk was present due to PCBs in surface soil. However, no specific criteria exists with regards to acceptable cleanup levels when driven by ecological risk. In lieu of any specific guidance, remediation goals for PCBs in soil were based on EPA Region III risk-based soil screening criteria (RBCs) for industrial soils. Thus, the remediation goal for PCBs was set at the RBC of 0.37 ppm.

The selected remedial alternative for surface soils at Site 21 was excavation and off-site disposal. This alternative and the corresponding remediation goal of 0.37 ppm for PCBs was documented in the ROD signed in September 1994.

SECTION III: REGULATORY REQUIREMENTS/COMMUNITY INVOLVEMENT

The change in the remedial goal for PCBs at Site 21 needed to be documented. This change constituted a significant deviation from the original ROD. Since the selected remedy was not fundamentally altered by this change, an amendment to the ROD was not required. Instead, an Explanation of Significant Differences was prepared, placed in the administrative record, and a notice summarizing the ESD was published in a local newspaper.

SECTION IV: OPTIONS CONSIDERED/COST AVOIDANCE

The LANTDIV RAC contractor was tasked with the excavation and disposal of the PCB and pesticide contaminated soils. Initial excavation work indicated that the areas of concern were potentially much larger than estimated based on RI sampling data. Faced with a potentially much larger and more costly project than originally anticipated or budgeted, the project team, consisting of LANTDIV, the RAC contractor, the RI/FS contractor, the State of North Carolina, and EPA Region IV, discussed possible alternatives. Field screening was performed to fully delineate the three areas of concern to estimate full excavation and disposal costs.

Results of the field screening confirmed that the AOCs were considerably larger than estimated. Field screening also allowed an evaluation of contamination levels within the areas of concern. Screening results showed that a considerable amount of the additional area to be excavated consisted of low levels of PCBs, only slightly above the remediation goal of 0.37 ppm. This was unexpected, as RI results indicated that contaminated areas exhibited consistently high levels of PCBs with little transition to clean areas (i.e. soils tended to be highly contaminated or clean). Since this remedial goal was based on a non-enforceable standard (EPA Region III RBCs, as driven by ecological risk), the project team decided to re-evaluate the selection of the remediation goal.

Several facts were brought out during the re-evaluation of the remedial goal. Between the time that the ROD was signed and the actual excavation commenced, the Region III RBC for PCBs in industrial soil was raised from 0.37 ppm to 0.74 ppm. Also, since the selected level was based on a non-enforceable standard, other applicable and standards were revisited to determine if a higher enforceable standard might apply. TSCA requirements and State of North Carolina standards were candidates. The lowest enforceable standard was the State of North Carolina standard, set at 1 ppm, and intended for residential soils. However, although not a formal standard, NC had previously applied a level 10 ppm at other industrial sites, and was willing to apply that level to Site 21. EPA Region IV was willing to support this level as well. In addition to being acceptable to regulators, a cost analysis showed that application of 10 ppm as a remedial goal for Site 21 would be financially feasible.

SECTION V: WHAT WORKED WELL

Formal partnering had recently been initiated with the MCB Camp Lejeune team when this issue arose. The project team included all primary stakeholders - regulators, activity representative, EFD, remediation contractor and investigation/design contractor. This allowed for a team approach to finding a solution. Once the problem was identified, all parties worked together to find an alternative that would be acceptable to all in a timely manner. In addition, no one on the team had ever been involved with a revision to a ROD of any kind, so the process of preparing an ESD was new to everyone. The team approach was a significant factor in the ultimate success of this project.

Although the team members all realized that there were provisions for amending a ROD in the NCP, in preparing the ESD we realized that we had tended to view RODs as unchangeable - fixed forever, no matter what circumstances may arise. However, we all learned a valuable lesson that RODs are not carved in stone; with sufficient justification and documentation, they can be modified when appropriate.

SECTION VI: IF WE HAD TO DO IT OVER AGAIN

Selection of remedial goals is rarely easy. In this case the original level was selected in order for the remedial alternative to be protective of both human health and the environment. In the absence of specific guidance regarding ecological risk, a protective level was chosen from relevant existing guidance. The original level specified was not thought to be much of an issue in terms of remedial cost because the RI results indicated that the contamination was concentrated in hot spots, with relatively abrupt transition to clean areas. Had the additional screening work that was eventually done during the RA phase been performed during the FS instead, a more accurate assessment of the areas of contamination could have been made, avoiding the budgetary surprise that initiated the re-evaluation of the remedial goal. In addition, the screening would have shown that a significant area of only slight contamination existed, which could have helped guide the selection of remedial goals for the original ROD, avoiding the need for an ESD.

NAVFAC RPM CASE STUDY No. 2

SECTION I: SITE INFORMATION

SITE/LOCATION: Groundwater at site 204 (old site F) NSB Bangor, WA

DESCRIPTION: Demil (washout) of ordnance into a 50' dia unlined lagoon

CONTACT: Gerry Reiger, EFA NW, 360 396 0063 DSN 744

TECHNOLOGY: Pump & Treat w/GAC

CONTAMINANTS: RDX, TNT, DNT, Nitrate

CONCENTRATION: 1300 ppb RDX; 460 ppb TNT; 5.23 ppb DNT; 17 ppm Nitrate

ACTION LEVELS: 0.8 ppb RDX in groundwater from applying criteria in State of WA Model Toxics Control Act. RDX is a suspected carcinogen. Remediating RDX to the required limit will capture other contaminates as well.

LEGAL DRIVER: CERCLA, NPL, NCP, FFA,

DECISION DOCUMENT: ROD

SECTION II: EXPERIENCES ENCOUNTERED

Demilitarization of ordnance by washing explosive out of shell casings occurred through the early 70s. Wash water from three buildings went to a small pond that overflowed down a 200 foot ditch. During the 70s & 80s, soil and groundwater contamination was characterized. A plume 3/4 of mile long and up to a 1/2 mile wide has reached a shallow aquifer at a depth of 50 to 100 ft. below ground surface. No contamination has been found in a discontiguous deep aquifer. A fixed price RI/FS was solicited in 1991 to limit firms to those with ordnance experience. FS recommended treatment with ultra violet light/ozone oxidation. NFESC (formerly NCEL) assisted by conducting bench and on-site, pilot treatability studies in 1992-93 financed through the NAVFAC R&D program. NFESC was able to retain expertise of the same RI/FS contractor under a different contract instrument which maintained continuity.

UV/ox was preferred due to complete destruction of contaminant. No one offered regeneration of ordnance contaminated GAC at the time. GAC would have to be landfilled thus transferring contamination. However, UV/ox was untried at necessary flow rates and process by-products had to be identified. Result showed UV to work; cost was slightly below GAC including disposal. At the same time, manufacturers of GAC began to offer return of GAC, having perfected a thermal regeneration system. The UV decision was reversed in 1994 in favor of known effective GAC which now included total contaminate destruction at a lower cost than UV oxidation.

Treated water is reintroduced downgradient of the plume as a contaminant barrier. WA State code requires permits and testing for reinjection since it implies introduction of contaminants. The potable quality water pumped back in the ground is therefore said to be reintroduced to avoid administrative burden of dealing with a "reinjection " system.

Placement of extraction wells has been based on a three dimensional flow model. Sensitivity is such that slight changes in input have indicated large variations in where to place wells. Contractor desire to manipulate the model to try to achieve perfect well placement has to be balanced against the need to stop studying and get on with remediation.

SECTION III: REGULATORY REQUIREMENTS/COMMUNITY INVOLVEMENT

An interim ROD was signed in 1991 calling for UV oxidation. It was a triumph for an innovative technology and the people who explained it to the regulators and public in hearings and TRC meetings. When, for cost reasons, the technology of choice was changed, the Navy had to submit an explanation of significant differences but not a full amendment of the ROD. Since technology and not the total concept was the only change, the formality was not difficult and a final ROD calling for GAC was signed in 1994.

RI/FS risk assessment based the Reasonable Maximum Exposure scenario on drinking the most contaminated well water even though the shallow aquifer is not used for water supply.

SECTION IV: OPTIONS CONSIDERED/COST AVOIDANCE

UV oxidation based on some preliminary work at NOS Indian Head and elsewhere appeared to offer potential for a state-of-the-art solution. An intense scientific and economic study followed, but the UV oxidation could not compete with the cost of the more well known carbon adsorption technology once regeneration was offered. GAC is estimated to be $1.3M less expensive than UV/ox over a projected 10 to 30 year operation.

SECTION V: WHAT WORKED WELL:

Trying different things until we got it right. A strong partnering and dialog between Navy, regulators and community allowed trying of a new method. The interface with the R&D program, though shaky at times, offered an alternative financing for study and brought more scientific creditability to the overall project. When ROD change needed to be made it was routine because trust had been established.

SECTION VI: IF WE HAD IT TO DO OVER AGAIN

Interim ROD was pushed by EPA and agreed to by Navy before it was certain which way we would go. It's better to wait on ROD until certain, if possible, to save on transaction costs. Many different people were involved in a complex project over some 5 years. A good simple record keeping system would have been helpful.

NAVFAC RPM CASE STUDY No. 3

SECTION I: SITE INFORMATION

SITE/LOCATION: Site 11, PSNS, Bremerton, WA

DESCRIPTION: TPH Contamination for two circa 1915 underground storage tanks (5 million gallon each).

CONTACT: Bill Schrock, EFA NW, 36O-396-0055, DSN 744-0055

TECHNOLOGY: Steam Sparging followed by in-situ bioremediation.

CONTAMINANTS: #5 and #6 Fuel Oil, diesel

CONCENTRATIONS: 40,000 ppm oil; 88,000 ppm diesel

LEGAL DRIVER: CERCLA NPL

DECISION DOCUMENT: Action Memorandum with EE/CA

SECTION II: EXPERIENCES ENCOUNTERED

Site 11 consists of two abandoned 5 million gallon underground storage tanks and one active 2 million gallon above ground storage tank. The tanks were field constructed between l910 and l915 in a steep ravine that drains into Puget Sound. During the Site Inspection five monitoring wells were installed that estimated approximately five feet of floating product on the groundwater at a depth of 105 feet bgs.

The state of Washington issued an enforcement order in 1992 requiring the Navy to conduct an RI/FS at the site starting in May 1993. The Navy decided to proceed with a "presumptive" remedy. The Navy presented the existing site information to the RAC contractor, Ebasco Environmental, and requested what technologies appeared to have the greatest likelihood of success. The RAC evaluated the existing information and due to the viscosity of the contaminant and the depth that which it was located, steam sparging presented the greatest potential for success. The Navy took this recommendation and presented it to the regulatory agencies for their buy-in. The Navy packaged the proposal as a demonstration program on a small portion of the site to be conducted under the Navy's removal action authority. The agency buy-in was critical since we wanted to postpone and potentially eliminate the RI/FS process. Agency buy-in was received and the RAC proceeded with the preparation of work plans for the demonstration program and bench scale testing. As part of the demonstration program, nature and extent data are being collected by the use of Vertical Induction Profiling (VIP) that is non-intrusive and provides 3-D results at a fraction of the cost of drilling. The demonstration program is slated for start-up in December 1995.

SECTION III: REGULATORY REQUIREMENTS/COMMUNITY INVOLVEMENT

The state is the lead regulatory agency for this NPL site and are very anxious for cleanup to be conducted rather than studying sites. This made the selling of the concept easier. Conducting the demonstration program as a removal action reduces both the administrative work required and also reduces the amount community involvement activities required. This does not mean the community is ignored, just that mandatory review periods were not necessary. Pending successful completion of the Demonstration Program, a ROD will be written that incorporates the results of the demonstration program, VIP study, and bench scale treatability tests.

SECTION IV: OPTIONS CONSIDERED/COST AVOIDANCE

The Navy and RAC evaluated approximately ten different alternatives for remediation of the site. The RAC previously performed steam sparging at a site in Virginia and California. At the Virginia site, three different alternatives (steam injection, hot water injection, and hot air injection) were evaluated and results of each technology were compared. Steam injection was clearly the best performing alternative.

Although steam sparging will not effectively remove all contamination from the site, it will remove the bulk of the contaminants and bioremediation is being evaluated as a polishing action to achieve final cleanup action levels. Another cost saving aspect was the availability of steam on-site.

SECTION V: WHAT WORKED WELL

The utilization of the RAC to develop the work plans and follow-on construction provided for continuity that would have normally been lacking on a project like this.

Having a clear understanding of what is important to your regulators prior to embarking on a project like this is critical. Our knowledge that the agencies were high on construction verse study enabled us to convince them up front that this was the best way to approach this site.

Conducting the initial phases of the project as a non-time critical removal action enabled the Navy and the RAC to make all decisions concerning the work plan development. Agencies were only given informational copies of the work plan as it was being developed which saved time and resources during review periods.

SECTION VI: IF WE HAD TO DO IT AGAIN

More long term planning up-front would have been useful. The original focus was only on conducting the demonstration project as a removal action and not much planning was considered beyond that. As the project has evolved and the likelihood of success has increased, detailed planning for how to get to the ROD has occurred. If this had been given more careful thought from the beginning, some data that may be critical to the execution of the ROD could have been gathered during the demonstration program.